Cantharidin from *Meloe niger* Kirby

(Coleoptera: Meloidae)

D. F. Mayer and C. A. Johansen[1]

Department of Entomology, Washington State University, Pullman 99163

Meloidae are the source of the medicinal drug cantharidin, commonly called Spanish fly. It has been generally assumed that all Meloidae with the possible exception of the tribe Horiini contain cantharidin (Selander, 1960; Pinto and Selander, 1970). However, much of the early literature is inaccessible and some of the early identifications are ambiguous. Actual analytic data are available for only about 33 of about 2,000 species, most of them belonging to the genera *Epicauta* and *Mylabris* (Dixon *et al.*, 1963; Carrel and Eisner, 1974.)

During a 4-year study of *Meloe niger* Kirby, a predator of the alkali bee, *Nomia melanderi* Cockerell, we tested for cantharidin in adult beetles. We believe this is the first positive analysis for cantharidin from a North American species of *Meloe*.

Methods and Procedures

Adult *M. niger* were collected from the field during March and April, 1976 and transported to the laboratory alive.

Blood samples obtained from reflex bleeding were treated according to Carrel and Eisner (1974), and tested for cantharidin. Whole adults were ground in dry ice with a mortar and pestle and extracted with chlorform according to a method modified from Dixon *et. al.* (1963).

Samples were injected into a Hewlett-Packard 5700A gas chromatograph. Two columns were used: a 1.83 m (6 ft) coil of 10% silicone rubber SE-30 on chromsorb W Aw 80-100 mesh, and 2) a 1.52 m (5 ft) coil of 5% OV1 gaschrom Q. A oven temperature of 200°C. was used.

Results and Discussion

The presence of cantharidin in *M. niger* was confirmed by gas chromatography-mass spectrometry from both blood samples and whole beetles with peaks corresponding to authentic pure cantharidin (supplied by Inland Alkaloid Co.). Blood contained 57 mM and whole beetles an average of 0.88 mg (0.12% of body weight) cantharidin.

The only previous, authenticated record of cantharidin in *Meloe* is Dixon *et. al.* (1963) in the European *Meloe proscarabeus* L. at 2mg (0.187% of body weight). Interestingly, Shimano *et. al.* (1953) tested

[1] Work conducted under Washington Agricultural Research Center Project No. 0147, Scientific Paper No. 4680.

for cantharidin in the Asiatic spp. *Epicauta gorhami* Marseul and *Meloe auriculatus* Marseul, finding it in the former but not the latter. Westwood (1839) also states that some *Meloe* are not servicable in medicine (*i.e.* do not contain cantharidin). Apparently, all *Meloe* do not contain cantharidin.

When disturbed, Meloidae respond by reflex bleeding, which consists of the emission of blood from the leg joints while the beetle remains immobile (death feigining). Male *M. niger* emit a maximum of 1 to 2 μl and females 8 to 10 μl. Male blood is a distinct red color and female blood a light yellow. Reflex bleeding is thought to be a nonglandular chemical defense mechanism with cantharidin, which is toxic to vertebrates and insects, functioning as a feeding deterrent. We have never seen reflex bleeding or death feigning by *M. niger* under natural conditions, but have observed it in the laboratory by hitting adult beetles a sharp rap with a probe and in the field when collecting and handling the beetles.

The general assumption is that vertebrates associate the delayed, noxious effects of cantharidin with the insect eaten and learn to discriminate against it (Carrel and Eisner, 1974). There is very little specific evidence of predation of Meloidae (Selander, 1960; Pinto and Selander, 1970) and we have not observed any predation on adult *M. niger.* In feeding tests, Meloidae have been refused as food without first becoming sick by baboons and falcons (Marshall, 1902); monkeys (Carpenter, 1921); lizards (Pritchell, 1902) and green sunfish (Tafanelli and Bass, 1968). This would suggest the "becoming sick-learning to discriminate" mechanism is not operating. A possible mechanism, suggested by Eisner (1970), is a chronic debilitating effect on predators into a species from which the tendency to capture the lethal prey is entirely selected out. This would call for a high order of selection pressure.

When placed near an ant colony *(Formica obscuripes* Forel), most adult beetles were able to escape without feigning death, though they were attacked by the ants. In one instance, we held the beetle among the ants until they punctured the beetle's abdomen. Ants that came in contact with blood from the puncture immediately backed away and began cleansing activities. The ants eventually succeeded in killing the beetle, but they did not use it for food. Carrel and Eisner (1974) found this same type of cleansing response by *Pogonomyrmex occidentalis* Cresson from contact with the blood of *Epicauta brunnea* Werner. They also established that cantharidin is a feeding deterrent to some insect predators and not others.

Meloid blood, due to the cantharidin, causes redness, pain, and blistering when applied to the human skin. We have not found this reaction in 10 humans that have contacted the blood of *M. niger.* Cantharidin in *M. niger* blood may be tightly bound to lipoproteins and therefore may not enter the human skin. The concentration of

cantharidin in *M. niger* blood is 57 mM, and this greatly exceeds the solubility of cantharidin in water. Alternatively, *M. niger* blood may contain a pharmacologically active principle which counteracts the effects of cantharidin.

Literature Cited

Carpenter, C. D. H. 1921. Experiments on the relative edibility of insects with special reference to their coloration. Trans. R. Entomol. Soc. Lond., 69: 1-106.

Carrel, J. E., and T. Eisner. 1974. Cantharidin: potent feeding deterrent to insects. Science, 183: 755-757.

Dixon, A. F. G., M. Martin-Smith, and S. J. Smith. 1963. Isolation of cantharidin from *Meloe proscarabeus*. Can. Pharm. J., Sci. Sect., 96: 501-503.

Eisner, T. 1970. Chemical defense against predation in arthropods, p. 157-217. *IN* Sondheimer, E., and J. B. Simeone (ed.), Chemical Ecology. Academic Press, New York.

Marshall, G. A. K. 1902. Five years' observations and experiments (1896-1901) on the bionomics of South African insects chiefly directed to the investigation of mimcry and warning colours. Trans. R. Entomol. Soc. Lond., 50: 287-584.

Pinto, J. D., and R. B. Selander. 1970. The bionomics of blister beetles of the genus *Meloe* and a classification of the new world species. Univ. Ill. Biol. Mono. 42, 222 pp.

Pritchell, A. H. 1903. Some experiments in feeding lizards with protectively colored insects. Biol. Bull., 5: 271-287.

Selander, R. B. 1960. Bionomics, systematics, and phylogeny of *Lytta* a genus of blister beetles (Coleoptera, Meloidae). Univ. Ill. Biol. Mono. 28, 295 pp.

Shimano, T. M., M. Mizujo, and T. Boto. 1953. Cantharidin and free amino acids in *Epicauta gorhami* and similar insects. Ann. Proc. Gifu Coll. Pharm., 3: 44-45. (Chem. Abstr. 59: 13308g).

Tafanelli, R. J., and J. C. Bass. 1968. Feeding response of *Lepomis cyanellus* to blister beetles (Meloidae). Southwest Natur., 13: 51-54.

Westwood, J. O. 1839. An introduction to the modern classification of insects, vol. 1. London.

SCIENTIFIC NOTE

Note on the Distribution and Host Relationship of *Idiomelissodes duplocincta* (Cockerell) in Mexico (Hymenoptera: Apoidea). — On 9 and 10 September 1976 I collected bees from blossoms of *Ferocactus* sp. (probably *F. wislizenii* (Engelm.) Britt. & Rose) growing in ornamental plantings on the campus of the Unidad Noroeste del Instituto Tecnologico y de Estudios Superiores de Monterrey. The site is located 14 km. south of Ciudad Obregón (ca. 27° 29' N, 109° 56' W) in the irrigated and heavily farmed Yaqui Valley of Sonora. I made collections between 1130 and 1200 on both days, and on September 10, I took one female of the little known eucerine bee, *Idiomelissodes duplocincta* (Cockerell) from an open blossom of one of the cacti.

Idiomelissodes duplocincta has been recorded in Mexico from Chihuahua and Coahuila by LaBerge (1956, Univ. Kansas Sci. Bull. 37: 911-1194) and from Baja California Sur by Zavortink (1975, Pan-Pacific Entomol. 51:236-242). Zavortink reported the ecological relationship of this deserticolous bee to *Ferocactus wislizenii* on the basis of observations made by him in Arizona and New Mexico.

My collection is the first record of *Idiomelissodes duplocincta* in the Mexican state of Sonora, and it helps to confirm the use of *Ferocactus* as a pollen source by this bee.

Thanks are due to Dr. Juan M. Mathieu, Director of the Unidad Noroeste at Ciudad Obregón, for his kind hospitality during my visit to that institution and to Dr. Wallace E. LaBerge of the Illinois Natural History Survey at Urbana for confirming the identity of the bee. — JOHN K. BOUSEMAN, *Illinois Natural History Survey, Urbana, Illinois 61801.*